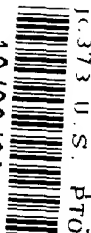


12/28/98



JC373 U.S. PTO

**TRANSMITTAL
APPLICATION**

Title: KNIFE INDEXING APPARATUS
INVENTOR: MARK RASPER AND TIM RULSEH

JC549 U.S. PTO

09/222282



12/28/98

To the Commissioner of Patents and Trademarks
Washington D. C. 20231

Sir,

Transmitted herewith is a patent application as described above. Enclosed are;

- 1 certificate of mailing
- 12 pages of application and claims
- 2 sheets of drawings
- 1 abstract
- 1 Declaration and Power of Attorney
- 1 Declaration Claiming Small Entity Status-Individual
- 1 Declaration Claiming Small Entity Status-Small Business
- 1 Self addressed post card
- 1 Money order in the mount of \$395.00 as the filing fee

Enclosed herewith under separate cover are;

- 1 Assignment cover sheet
- 1 Assignment
- 1 Money order in the amount of \$40.00 as the registration fee.
- 1 self addressed post card

By

Russell L. Johnson
Patent Agent (26,918)
Post Office Box 161
Weyauwega WI 54983
414/867-3482

Certificate of Mailing

I hereby certify that this correspondence is being deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to:

The Commissioner of Patents and Trademarks
Washington D.C. 20231
on December 22, 1998

(Date)

Russell L. Johnson

(Name of person making deposit)

(Signature)

December 22, 1998

(Date)

VERIFIED STATEMENT CLAIMING SMALL ENTITY STATUS
(37 CFR 1.9(f) & 1.27(b)--INDEPENDENT INVENTOR

Applicant or Patentee: MARK RASPER and TIM RULSEH
Serial or Patent No: NA
Filed or Issued: NA
Title: KNIFE INDEXING APPARATUS

As a below named inventor, I hereby declare that I qualify as an independent inventor as defined in 37 CFR 1.9(c) for purposes of paying reduced fees to the Patent and Trademark Office described in:

- ☒ the specification filed herewith with title as listed above.
☐ the application identified above.
☐ the patent identified above.

I have not assigned, granted, conveyed or licensed and am under no obligation under contract or law to assign, grant, convey or license, any rights in the invention to any person who would not qualify as an independent inventor under 37 CFR 1.9(c) if that person had made the invention, or to any concern which would not qualify as a small business concern under 37 CFR 1.9(d) or a nonprofit organization under 37 CFR 1.9(e).

Each person, concern or organization to which I have assigned, granted, conveyed or licensed or am under obligation under contract or law to assign, grant, convey, or license any rights in the invention is listed below:

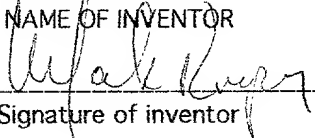
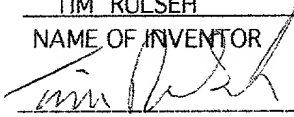
- ☐ No such person, concern, or organization exists.
☒ Each such person, concern or organization is listed below.

PRODUCTIVE SOLUTIONS, INC. 1025 BREEZEWOOD LANE, NEENAH WI 54956

Separate verified statements are required from each named person, concern or organization having rights to the invention averring to their status as small entities, (37 CFR 1.27)

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement of small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b))

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

<u>MARK RASPER</u>	<u>TIM RULSEH</u>	
NAME OF INVENTOR	NAME OF INVENTOR	NAME OF INVENTOR
		
Signature of inventor	Signature of inventor	Signature of inventor
<u>12/18/98</u>	<u>12-18-98</u>	
Date	Date	Date

VERIFIED STATEMENT CLAIMING SMALL ENTITY STATUS
(37 CFR 1.9(f) & 1.27(c) -- SMALL BUSINESS CONCERN

Applicant or Patentee: MARK RASPER and TIM RULSEH
Serial or Patent No. : _____
Filed or Issued: _____
Title: KNIFE INDEXING APPARATUS

I hereby declare that I am

- ☐ the owner of the small business concern identified below:
☒ an official of the small business concern empowered to act on behalf of the concern identified below:

NAME OF SMALL BUSINESS CONCERN PRODUCTIVE SOLUTIONS INC.
ADDRESS OF SMALL BUSINESS CONCERN 1025 BREEZEWOOD LANE, NEENAH WI, 54957

I hereby declare that the above identified small business concern qualifies as a small business concern as defined in 13 CFR 121.12, and reproduced in 37 CFR 1.9(d), for purposes of paying reduced fees to the United States Patent and Trademark Office, in that the number of employees of the concern, including those of the affiliates, does not exceed 500 persons. For purposes of this statement (1) the number of employees of the business concern is the average over the previous fiscal year of the concern of the persons employed on a full-time part-time or temporary basis during each of the pay periods of the fiscal year, and (2) concerns are affiliates of each other when either, directly or indirectly, one concern controls or has the power to control the other, or a third party or parties controls or has the power to control both.

I hereby declare that rights under contract or law have been conveyed to and remain with the small business concern identified above with regard to the invention described in;

- ☐ the specification filed herewith with title as listed above.
☒ the application identified above.
☐ the patent identified above.

If the rights held by the above identified small business concern are not exclusive, each individual, concern or organization having rights in invention must file separate verified statements averring to their status as small entities, and no rights to the invention are held by any person, other than the inventor, who would not qualify as an independent inventor under 37 CFR 1.9(c) if that person made the invention, or by any concern which would not qualify as a small business concern under 37 CFR 1.9(d), or a nonprofit organization under 37 CFR 1.9(e).

- Each person, concern or organization having any rights in the invention is listed below:
☒ no such person, concern, or organization exists.
☐ each person, concern or organization is listed below.

Separate verified statements are required from each named person, concern or organization having rights to the invention averring to their status as small entities. (37 CFR 1.27)

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b))

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

NAME OF PERSON SIGNING RONALD HIRN
TITLE OF PERSON IF OTHER THAN OWNER TREASURER
ADDRESS OF PERSON SIGNING P. P. BOX 616, NEENAH, WI 54957
SIGNATURE *Ronald Hirn* DATE 12-18-95

KNIFE INDEXING APPARATUS

CROSS-REFERENCE TO RELATED APPLICATION

This application claims the benefits of Provisional Patent Application 60/070,405 filed 01/05/98.

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

This invention relates to non-rotating circular knives used in cutting cores to length.

More specifically, this inventions relates to means for automatically indexing a core cutting knife to present a fresh cutting edge to the work.

BACKGROUND OF THE INVENTION

Non-rotating circular knives are a preferred instrument for cutting cores to length.

A common mode of cutting cores is to mount a length of core on a mandrel and position the core relative to a knife that is movable towards and away from the core. The core is then rotated and the knife advanced into the core until a core segment of the desired length is severed from the core. The knife is then retracted and the

core advanced on the mandrel to a new cutting position and the cycle is repeated.

The materials and methods used in forming cores are intended to make cores as tough and durable as is practical. The result is that cores are not easy to cut. Knife wear and thermal degradation as well as some mechanical damage are present in nearly every cut. This results in a relatively short life for the cutting edge and the frequent need to provide a new cutting edge.

Present practice is for an operator to monitor the cut and when he becomes aware that the knife had degraded to a point where the degradation is adversely effecting the cut, the knife is rotated to provide a new edge. Both the knife indexing apparatus and the method of indexing the knife are simple and straightforward.

Upon determination that the knife degradation requires the provision of a fresh cutting edge, an operator stops the cutting process, loosens the knife on its mount, rotates the knife to present a new edge, tightens the knife on its mount, and restarts the cutting process.

Heretofore, it has been common practice in the art to rotate the knife on a fixed mandrel to present a new cutting edge to the work. Typically, the rotation is done by hand and by eye and without regard to the direction in which the knife is rotated relative to the direction of rotation of the work being cut. As a consequence of this imprecise and unknowing approach, the number of knife repositionings that were had before the useful perimeter of the knife

was consumed was often four or less.

The indexing apparatus of this invention increases the number and quality of the cuts that can be made with a single knife while reducing knife cost and machine down time.

The indexing means of this invention enables the precise repositioning of the knife without interrupting a cutting cycle, and as a consequence makes practical the programing and automating of knife indexing so that operator intervention relating to the knife is required only to remove a consumed knife and replace it with a fresh one.

The present invention involves methods wherein the number of cuts are summed and when they reach a predetermined number, the knife is rotated to present a new edge. The core cutting operation is thereby rendered more efficient and safe. Advancements in technologies and techniques have permitted the improvement of the knife indexing apparatus to the point wherein it can be fully automatic and requires only infrequent operator attention.

It has been discovered that the pattern of knife edge degradation is not symmetrical about the radius of the knife along which the knife is advanced. This discovery has lead to the discovery that the angle through which a knife needs to be rotated to provide a new cutting edge for the cutter is greater in one direction of rotation than it is in the other direction of rotation. If the knife is rotated so that it moves with the direction of rotation of the core the angle of

rotation needed to reach a fresh edge is less than the angle of rotation needed to reach a fresh edge if the knife is rotated against the direction of rotation of the core.

This invention combines discoveries of the inventor with advances in the art to provide novel and unobvious improvements in a core cutting knife indexing apparatus.

It is an object of this invention to provide a knife indexing apparatus that combines known mechanisms and means with new discoveries and art knowhow to provide a knife indexing apparatus for non-rotating circular knife core cutters that is an improvement in the state of the art.

It is further an object of this invention to provide the knife indexing apparatus as described above wherein the combinations of mechanisms and means admit to automation to the degree that operator interaction is not required during the useful life of the circular knife.

It is further an object of this invention to provide the knife indexing apparatus as described above wherein art knowledge and discoveries are incorporated with suitable mechanisms and means to provide a knife indexing apparatus that is more efficient, accurate, and reliable than prior art core cutting knife indexing apparatus.

Other objects will be made apparent by the following specifications, claims and the attached drawings.

DESCRIPTION OF RELATED ART

The prior art does not provide an apparatus for automatically indexing a non rotating core cutting knife in the direction of rotation of the core to be cut.

Most of the technologies and mechanisms used in this invention are known in the core cutting art.

Prior art practices in repositioning non-rotating core cutting knives have been to rotate the knife against the rotation of the core to be cut to avoid introducing lash or play into the knife holding assembly or the rotations have been made without regard to the direction of rotation of the core to be cut.

It has been discovered that the degradation of the edge of the knife is not symmetrical about the radius along which the knife is advanced into the core. This invention embodies that discovery in an apparatus that repositions the core cutting knife by rotating it in the direction of least degradation. This permits the rotation of the knife through a smaller angle to reach a fresh edge than would be the case if the knife were rotated in the opposite direction. Depending on the thickness of the core being cut and the material that it is made of, this procedure results in the increase of one or more knife indexing cycles before the edge of the knife is completely degraded than would be the case if the knife were rotated in the opposite direction with the same degree of precision as provided by the index of this invention.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a fragmentary elevational schematic view of a fixed circular knife in the process of executing a core cut.

Figure 2 is a schematic pictorial view of the elements of the knife indexing apparatus of this invention illustrating the functional relationships of the elements of the indexing apparatus.

Figure 3 is a flow chart of the operation sequencing of the knife indexing apparatus of this invention.

Figure 4 is an elevational pictorial view in partial section showing a positional index for the knife of this invention.

BRIEF DESCRIPTION

The invention in one of its simplest forms is; a knife indexing apparatus comprising; a rotatable mandrel, a circular knife fixedly mounted on said mandrel, a worm gear fixedly mounted on said mandrel, a worm having a shaft and the worm is operably engaged with said worm gear, an overrunning coupling engaged with said shaft of said worm, a rotary actuator connected to the overrunning coupling and a means for actuating said coupling so as to rotate said knife through a set angle in the direction of rotation of a core to be cut.

The method of operating said knife indexing apparatus comprises the steps of; advancing a knife indexing apparatus into a core to effect a core cut, withdrawing the knife indexing apparatus, incrementing a counter, interrogating the counter, repeating the cycle until the counter indicates a preestablished condition, activating a rotary

actuator which rotates the overrunning coupling to rotate the shaft of the worm a preestablished distance which causes the worm gear to rotate the mandrel which causes the knife to rotate through a preestablished angle, returning the overrunning coupling to its starting position, returning the counter to its starting position, and starting a new knife indexing cycle.

DETAILED DESCRIPTION

In the drawings like numbers refer to like objects and the proportions of some elements have been modified to facilitate illustration.

Referring now to figure 1 wherein core 1 is shown to rotate in the direction of arrow C. Non-rotating knife 2 is advancing radially in the direction of arrow K to effect a core cut. As knife 2 advances into core 1 friction and heat build up and cause degradation of knife 2 in a pattern shown as cross hatched degradation area 3. When the edge of knife 2 has degraded to the degree that a new edge should be presented along radial axis A, it can be seen that knife 2 will present a new edge along axis A when rotated through an angle S in the direction of rotation of arrow C. A rotation through an angle L will be required to present a new edge when knife 2 is rotated in the direction against rotation arrow C. Angle L is appreciably greater than angle S.

The illustrations of figure 1 are schematic and the above descriptions of the phenomenon are incomplete, but they will serve to communicate the discovery that the degradation of knife 2 is not uniform about its radial cutting axis. They will also serve to

communicate the collateral discovery that rotation of knife 2 in the direction with the rotation of core 1 will result in a smaller angle of rotation to reach a new edge than would be the case if knife 2 were rotated against the direction of rotation of core 1. As a result, more fresh cutting edges can be indexed into position when rotating knife 2 in one direction than would be the case if knife 2 were rotated in the opposite direction.

It has been found that significant savings in knife cost due to an increase in the number of quality cuts achievable per knife and significant operating cost savings due to reductions in machine down time can be achieved by employing automated apparatus to perform the various tasks now performed manually. The knife indexing apparatus of figure 2 is a preferred method of providing an automated knife indexing apparatus for core cutters.

Referring now to figure 2 wherein a knife indexing apparatus 10 is illustrated schematically. Knife indexing apparatus 10 has knife 2 fixedly mounted on rotatable arbor 11. Arbor 11 has fixedly mounted thereon worm gear 12 which is operably engaged with rotatable worm 13 which has as a part thereof, worm shaft 14. Shaft 14 is joined to overrunning coupling 15. Overrunning coupling 15 has the characteristic that it will rotate worm shaft 14 when rotated in one direction and will rotate on worm shaft 14 when rotated in the opposite direction. Overrunning coupling 15 is engaged with rotary actuator 16 which serves to rotate overrunning coupling 15 through a preset angle and then counter rotate it to its starting position.

The apparatus described above is capable of indexing the knife in the

interval between the end of one cut and the beginning of another cut so that the core cutting operations need not be interrupted to index the knife. The precision, efficiency, and reliability of the knife indexing is enhanced by the employment of modern electronic sensing and control means. In figure 2 event sensor 17 serves to detect each cutting cycle of apparatus 10. A signal is transmitted to index controller 18. Controller 18 interprets the signal from sensor 17 and when programmed to do so sends an indexing command to rotary actuator 16 to index knife 2.

Referring now to figure 3 which is a flow chart illustrating the operational sequencing of a fully automated core knife indexing apparatus that would require no operator intervention during the useful life of the knife edge.

The angle through which the knife is rotated in one repositioning or indexing cycle is in the preferred embodiment set into the indexing apparatus and remains constant for the apparatus until changed by a resetting procedure. The cut counter and the index counter are set at zero and return to that value when reset.

The operational sequence after the start 30 of the core cutting operation is to; cycle 31 the knife through a cut; step the cut counter 32 (add one); interrogate the cut counter 33, if the cut counter has not reached the set value, take the return path to another cutting cycle 31; if the cut counter 33 has reached the set value take the knife index 34 path and index the knife; then step the index counter (add one); interrogate the index counter 36; if the index counter has not reached the set value, take the path to reset

the cut counter 37 to zero and return to cycle 31 to again start a cut counting sequence; if the index 36 has reached the set value, activate a signal 38 and stop cutting operations.

The above sequence permits the continuous operation of the core cutter during the useful life of the knife.

Referring now to figure 4 wherein a arbor 40 is provided with positional index 41 which is here shown as a key and keyway which is a common positional index used in the art.

The above disclosures are enabling and teach the best methods of practicing the invention known to the inventors at the time the invention was made. The apparatus of this invention comprises Mechanisms, apparatus and technologies that are known in the art separately and in different combinations. Further, equivalent mechanisms, apparatus and technologies could be substituted for those disclosed above without departing from the novel combination of elements of this invention.

Therefore, the scope of this invention should not be limited by the above disclosures but the scope of this invention should be limited only by the scope of the appended claims and all equivalents thereto that would become apparent to one skilled in the art.

What is claimed is:

Claim 1

An indexing means for a non-rotating circular core cutting knife comprising;

a) a circular knife defining a central orifice and a positional index adjacent to the central orifice,

b) a knife mounting mandrel sized to pass through and closely fit the central orifice,

c) an positional index engaging means secured to the mandrel,

d) a means for securing the knife in place on the mandrel,

e) a worm gear secured to the mandrel,

f) a worm shaft having as a part thereof a worm and the worm is operably engaged with the worm gear,

g) an overrunning coupling operably secured to the worm shaft so that the coupling in an engaged portion of a cycle rotates the knife in the direction of rotation of a core being cut.

h) a means for counting cutting cycles of the knife and a means for counting indexing cycles of the indexing means,

i) a means for activating the knife indexing means when a preset number of cutting cycles has been completed and a means for

terminating cutting operations when a predetermined number of indexing cycles has been completed and a predetermined number of cutting cycles has been completed.

Claim 2

A method of automating the operations of the means of claim 1 comprising: the steps of,

- a) making a cut,
- b) stepping a cut counter,
- c) interrogating the cut counter,
- d) repeating steps a-c until the cut counter reaches a preset value,
- e) indexing the knife,
- f) stepping an index counter,
- g) interrogating the index counter
- h) resetting the cut counter,
- i) repeating steps a-h until the index counter reaches a preset value,
- j) terminating cutting operations when the index counter has reached the preset value.

ABSTRACT

The invention is for a knife indexing apparatus for a non-rotating core cutting knife and a means for automatically indexing the knife during core cutting operations. The apparatus employs the discovery that by indexing the knife in the direction of rotation of the core, at least one additional fresh cutting edge can be presented to the work than would be the case if the knife were rotated in the direction opposite to the direction of rotation of the core to be cut.

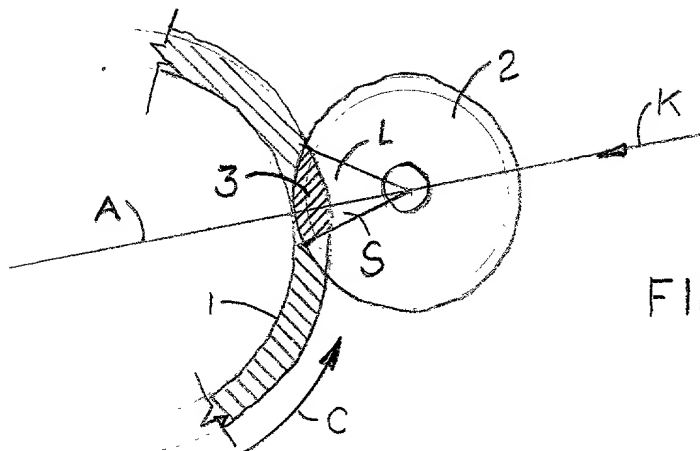


FIG. 1

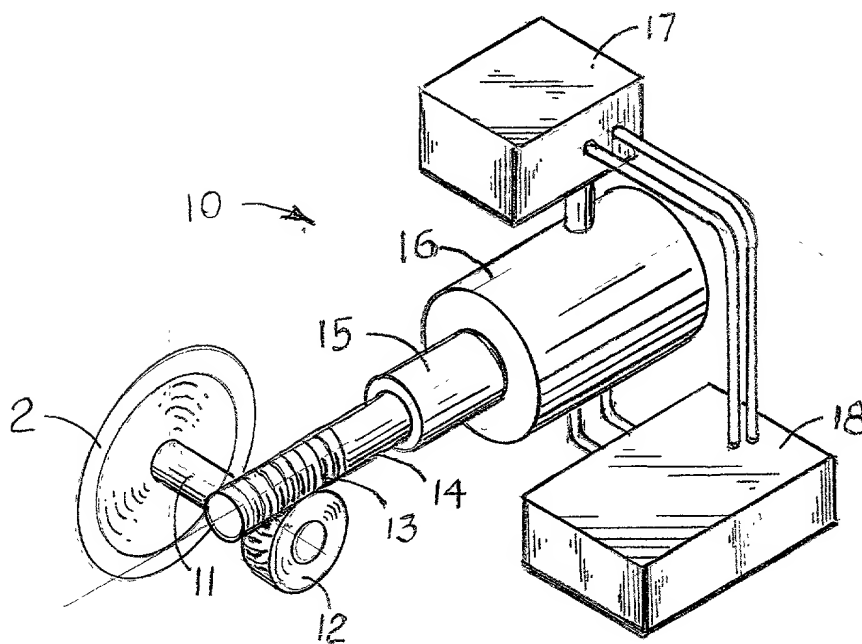


FIG. 2

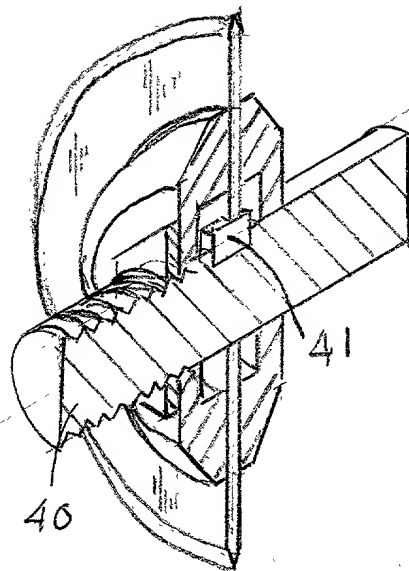
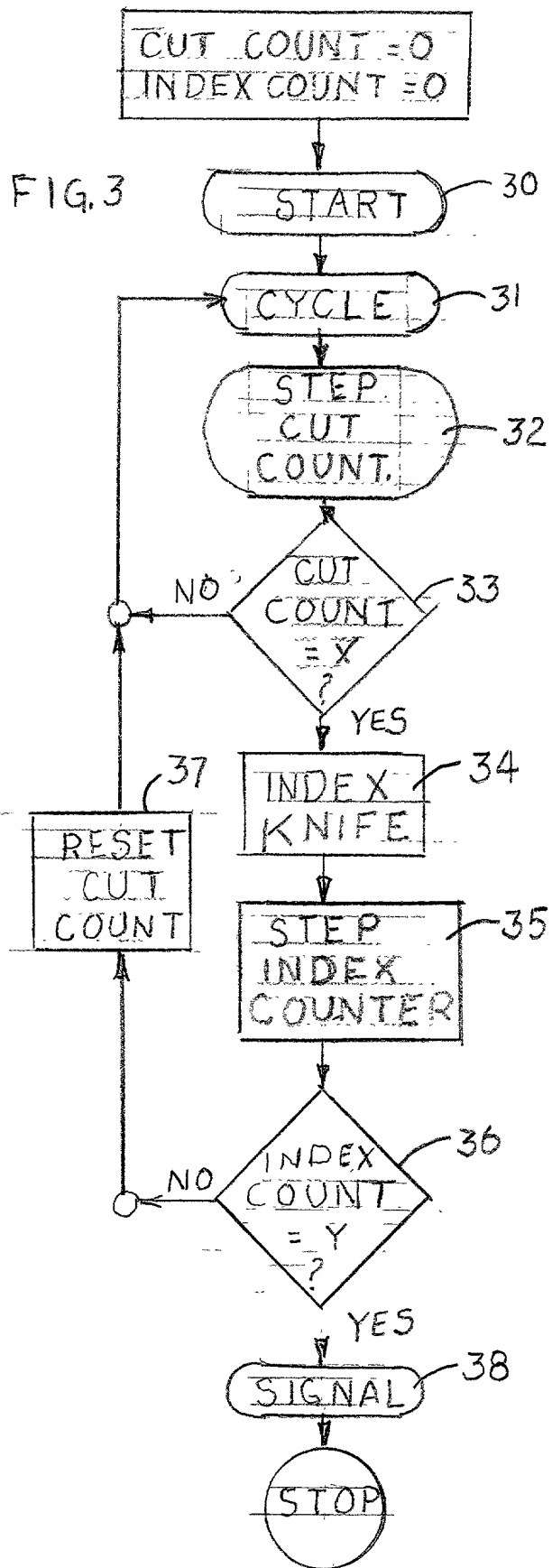


FIG. 4

DECLARATION AND POWER OF ATTORNEY - PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled
KNIFE INDEXING APPARATUS, the specification of which is attached hereto unless the following box is checked.

☐ was filed on _____ as United States Application Number or PCT International Application Number _____ and was amended on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56.

I hereby claim foreign priority benefits under 35 USC 119(a)-(d) or 35 USC 365(b) of any foreign application(s) for patent or inventor's certificate or 35 USC 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s)

Priority Not Claimed

_____	_____	_____	<input type="checkbox"/>
(Number)	(Country)	Day/Month/Year Filed	
_____	_____	_____	<input type="checkbox"/>
(Number)	(Country)	Day/Month?Year Filed	

I hereby claim the benefit under 35 USC 119(e) of any United States provisional application(s) listed below.

<u>60/070,405</u>	<u>01/05/98</u>
(Application Number)	(Filing Date)
_____	_____
(Application Number)	(Filing Date)

I hereby claim the benefit under 35 USC 120 of any United States

application(s), or 35 USC 365(c) of any PCT International application designating the United States, listed below and insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 USC 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application.

(Application Number)

(Filing Date)

(Status--patented, pending, abandoned)

(Application Number)

(Filing Date)

(Status--patented, pending, abandoned)

I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

Russell L. Johnson Patent Agent, Registration Number (26,918)

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Russell L. Johnson

414/867-3482

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full Name of sole or first inventor MARK RASPER

Inventor's Signature *Mark Rasper* Date 12/18/98

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Full Name of second joint inventor, if any TIM RULSEH

Second inventor's signature *Tim Rulseh* Date 12-18-98

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☐ Additional inventor's are being named on separately numbered sheets attached hereto.